IN THE UNITED STATES PATENT AND TRADEMARK OFFICE

Applicants: TANAKA et al

Serial No.: 08/838,910

Filed: April 11, 1997

Title: OXYGEN CONCENTRATION DETECTOR

Examiner: T. Tung

Art Unit: 1744

#32

6/30/99

* * * * *

June 15, 1999

BRIEF ON APPEAL

Honorable Commissioner of
Patents & Trademarks
Washington, D. C. 20231

Sir:

In response to the final Office Action dated September 14, 1998 and the Advisory Action dated April 23, 1999, Applicants submit herewith this Brief on Appeal in triplicate as required by 37 C.F.R. § 1.192.

(1) REAL PARTY IN INTEREST

The real party in interest is Nippondenso Co., Ltd., the assignee of record of the above-identified application by Assignment recorded on August 31, 1995 at Reel 7649, Frame 0908.

(2) RELATED APPEALS AND INTERFERENCES

There are no related appeals and/or interferences which will directly affect or be directly affected by or have a bearing on the Board's decision in the pending appeal.

(3) STATUS OF THE CLAIMS

Claims 12-15 and 21-37 remain pending. Claims 12-15 and 27-30 stand allowed. The rejection of claims 21-26 and 31-37 is appealed.

(4) STATUS OF AMENDMENTS FILED SUBSEQUENT TO FINAL REJECTION

A Notice of Appeal was filed on March 15, 1999.

An Amendment under 37 C.F.R. § 1.116 was filed on April 7, 1999. The Advisory Action of April 23, 1999 indicates that the April 7, 1999 Rule 116 Amendment has been entered.

(5) CONCISE EXPLANATION OF THE INVENTION

The invention relates to an oxygen concentration detector having a built-in heater. (Page 1, lines 11-13.)

Referring generally to Figure 1, the inventive oxygen concentration detector comprises a sensor element 2 including a solid electrolyte 20 with both an external surface 220 and an internal surface 230. An external electrode 22 is formed on the external surface 220 of the solid electrolyte 20, and an internal electrode 23 is formed on the internal surface 230 of the solid electrolyte 20. A heater 3 is built into the sensor element 2 to heat the electrodes and thereby facilitate the stabilization of the electrodes. (Page 7, lines 4-10.) This invention attains the object of accelerating the rate at which the electrodes are heated by employing one or more high-emissivity layers 1, the function of which will be explained below. (Page 2, lines 2-7.)

Generally, the high-emissivity layer is provided on (or constitutes) the internal surface of the sensor and/or is provided on (or constitutes) the surface of the heater. (Page 2, lines 8-21.)

Where the high-emissivity layer is provided on or constitutes the internal surface of the sensor element, the high emissivity layer absorbs heat radiated from the heater and efficiently transfers heat to the solid electrolyte. (Page 3, lines 21-24.) Preferably, the high-emissivity layer provided on the internal surface of the sensor element has an emissivity of at least 0.3 and consists of alumina, titanium oxide, zirconium oxide, iron (III) oxide, nickel oxide, magnesium oxide, copper oxide, cobalt oxide, chromium oxide, yttrium oxide, cordierite, silicon nitride, aluminum nitride, and/or silicon carbide. (Page 2, lines 15-17 and page 2, line 22 to page 3, line 1).

Where the high-emissivity layer is provided on or constitutes the surface of the heater, the high-emissivity layer absorbs heat from the heater and efficiently radiates the heat to the internal surface of the sensor element. (Page 3, line 25 to page 4, line 1.) The high-emissivity layer provided on the heater preferably has an emissivity of at least 0.6 and consists of iron (III) oxide, nickel oxide, manganese oxide, copper oxide, cobalt oxide, chromium oxide, manganese oxide, copper oxide, chromium oxide, silicon nitride, aluminum nitride, and/or silicon carbide. (Page 2, lines 17-20 and age 3, lines 2-7.)

According to one embodiment depicted in Figures 1-4 and covered by claims 21-26 and 36, the high-emissivity layer 1 is provided on the surface of the internal electrode 23 to form a clearance between the high-emissivity layer 1 and the heater 3 of 0.1 mm or more. The high-emissivity layer 1 of this embodiment has a porosity of more than 10 percent.

According to another embodiment depicted in Figures 5 and 6 and covered by **allowed** claims 27-30, the high-emissivity layer 1 has an emissivity of 0.6 or more and is provided on the heater 3 to create a clearance from the internal electrode 23.

According to yet another embodiment covered by claim 31,[1] first and second high-emissivity layers each have an emissivity of 0.3 or more and are respectively provided on the surface of the heater and the surface of the internal electrode, with a clearance of at least 0.1 mm being present between the first and second high-emissivity layers.

According to still another embodiment cover by claims 32-35 and 37, the heater itself is formed from a material having an emissivity of 0.6 or more.

According to a further embodiment covered by **allowed** claims 12-15 and shown in Figure 14, internal electrode 239 itself consists of a material having an emissivity of 0.3 or more, whereas the external electrode 229 consists of a material having an emissivity lower than the emissivity of the internal electrode 239.

(6) CONCISE EXPLANATION OF THE ISSUES PRESENTED FOR REVIEW

(a) Whether the features recited in claims 21-26 and 31 are supported by the original disclosure so as to place the claims in compliance with 35 U.S.C. § 112, first paragraph.

(b) Whether claims 21-26 and 36 are rendered unpatentable under 35 U.S.C. § 103(a) as unpatentable over U.S. Patent No. 4,540,479 to Sakurai et al. (hereinafter

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[1] Claim 31 stands rejected under Section 112, first paragraph, but is not currently rejected over the art of record.

"Sakurai") in view of U.S. Patent No. 4,452,687 to Torisu et al. (hereinafter "Torisu") and U.S. Patent No. 4,021,326 to Pollner et al. (hereinafter "Pollner").

(c) Whether claims 21-26 and 36 are rendered unpatentable under 35 U.S.C. § 103(a) over Torisu in view of Sakurai et al., U.S. Patent No. 4,212,720 to Maurer et al. (hereinafter "Maurer") or U.S. Patent No. 4,900,412 to Ker et al. (hereinafter "Ker"), and Pollner et al.

(d) Whether claims 32-35 and 37 are rendered unpatentable under 35 U.S.C. § 103(a) as unpatentable over Ker et al. in view of U.S. Patent No. 4,935,118 to Agarwal et al. (hereinafter "Agarwal").

(7) GROUPING OF THE CLAIMS

Claims 21-26 and 36 stand or fall together.

Claims 32-35 and 37 stand or fall together, but stand or fall separately from claims 21-26 and 36.

(8) ARGUMENTS

(a) The Subject Matter of Claim 21 (and claims 22-26 which depend therefrom) and Claim 31 are Supported by the Original Disclosure

The following expressions were rejected as containing subject matter which allegedly was not described in the specification in such a way as to reasonably convey to one skilled in the relevant art that the inventors, at the time the application was filed, had possession of the claimed invention:

1. In claim 21, the expression "said internal electrode has an emissivity less than that of said high-emissivity layer"; and

2. In claim 31, the expression "said internal electrode has an emissivity less than that of said second high-emissivity layer".

Essentially, both claim 21 and 31 are directed to an embodiment in which the internal electrode on which the high-emissivity layer is provided has an emissivity that is less than that of the high-emissivity layer.

As explained above, this invention encompasses several embodiments, including, *inter alia*, both an embodiment in which the internal electrode is provided with a high-emissivity layer (claims 21 and 31), and an embodiment in which the internal electrode constitutes a high-emissivity layer (claim 12). These are different embodiments. The purpose behind forming a high-emissivity layer on the internal electrode (as set forth in claims 21 and 31) is to produce high emissivity even when the internal electrode is not itself formed from a high emissivity material. As the skilled artisan would appreciate, there would not be any advantage to providing the high-emissivity layer on a higher-emissivity internal electrode. Thus, the original disclosure inherently, if not explicitly, discloses that the high-emissivity layer provided on the internal electrode has a emissivity which is higher (thus, its labeling as a "high-emissivity" layer) than the internal electrode.

In the Advisory Action, the Examiner points to page 21, line 14 of the specification, which states that the internal electrode is made of Pt black. However, the passage to which the Examiner points concerns the embodiment depicted in Figure 14. That embodiment involves the formation of the internal electrode from a high-emissivity material, and, therefore, is covered by claim 12, not claims 21 and 31.

Additionally, support for claim 21 can be found in Figure 1 of the application, in which the internal electrode 23 comprises a platinum layer. The high-emissivity layer 1 formed of a material has a higher emissivity than the platinum internal electrode 23. (*See* page 7, lines 11-25.)

For these reasons, reversal of the Section 112, first paragraph rejection is respectfully requested.

(b) The Claimed High-Emissivity Layer with a Porosity of More Than 10 Percent is Not Taught by the Art of Record and, Therefore, Claims 21-26 Are Patentable Under 35 U.S.C. § 103

Independent claims 21 and 36 both recite that the high-emissivity layer is provided on the internal electrode has a porosity of more than 10 percent.

The Examiner has cited to Sakurai and Torisu as disclosing, in combination, the structure set forth in independent claims 21 and 36. However, as acknowledged by the Examiner, Sakurai and Torisu, when taken alone or in combination, fail to teach or reasonably suggest the claimed porosity for the alleged high-emissivity layer.

To overcome this deficiency, the Examiner points to Pollner, which allegedly discloses an external electrode protective layer having a porosity of 1-50%. However, Pollner is devoid of any teaching or reasonable suggestion that the material selected for constructing its external electrode protective layer may also be used on the surface of an internal electrode.

The absence of any teaching in Pollner that its external electrode protective layer may be used to protect an internal electrode is not surprising, since protective layers for protecting internal electrodes serve different functions than those for protecting external electrodes. External electrode protective layers, such as the one disclosed in Pollner, are generally used

for preventing liquid-like impurities contained in exhaust gas from adhering on the external electrode. By contrast, as described in JP-A-215059 (of record), protective layers placed on internal electrodes are not designed to protect the internal electrode from exhaust gas. Rather, internal electrode protective layers are designed prevent sensor output from being decreased by silicon gas (generated from silicon components), which adheres to and poisons the internal electrode. It is understood by those of ordinary skill in the art that such poison-preventing layers require a fine porosity to effectively block the silicon gas from reaching the internal electrode. Thus, the internal electrode protective layer would need a porosity smaller than 10% to function effectively.

JP 1-77946 and JP 2-287251 (both of record), when taken in combination, further support Applicants' contention that internal electrode protective layers have porosities smaller than 10%. JP '946 describes an oxygen sensor having an internal electrode (2) and an external electrode (3), shown in Figures 1(a) and 1(b). As shown in Figure 1(b), an inner protective layer (5) is formed on an inner surface of the internal electrode (2). The inner protective layer (5) is mainly composed of heat-resistant oxide such as SiO_2, and is formed into a glass-like structure in which its **atomic** arrangement has a retinal structure. Further, JP '946 teaches treating its SiO_2 protective layer at 1500°C, which would produce a structure having a fine porosity.

There is no motivational teachings in the art to modify the porosities of the internal protective layers of these references to match the claimed range of more than 10%. The claimed porosity range was selected in order to permit air access to the electrode. The cited art is devoid of any suggestion of modifying its protective layer to achieve this function.

For these reasons, it is respectfully submitted that the Section 103(a) rejection of claims 21-26 and 36 is misplaced. Therefore, reversal of the rejection is respectfully requested.

(c) Neither Maurer or Ker Teach The Claimed High-Emissivity Layer with a Porosity of More Than 10 Percent and, Therefore, Claims 21-26 Are Patentable Under 35 U.S.C. § 103

As discussed above, Torisu, Sakurai, and Pollner, when taken alone or in any combination, fail to teach or reasonably suggest an internal electrode protective layer having a porosity of more than 10%. Maurer and Ker, which were cited as allegedly disclosing positioning a heater within a solid electrolyte element, do not overcome this deficiency.

For this reason, reversal of the Section 103(a) rejection of claims 21-26 and 36 is respectfully requested.

(d) The Provision of a High-Emissivity Heater Adjacent an Internal Electrode is not Taught by Ker and Agarwal, and Therefore, Claims 32-35 and 37 Are Patentable Under 35 U.S.C. § 103

Claim 32, as well as claims 33-35 and 37, which depend therefrom, are directed to an embodiment in which the heater has an emissivity of 0.6 or more and is disposed adjacent to the internal electrode to form a clearance therebetween of 0.1 mm or more.

Ker discloses an oxygen sensor having a heater adjacent to an inner electrode. Unlike the claimed invention, however, Ker does not disclose making the heater from a material having an emissivity of 0.6 or more. The formation of the heater from a material having the claimed emissivity characteristics provides the unexpected result of overcoming the problem

of heat accumulation, which is especially peculiar for a heater disposed within a solid electrolyte.

To overcome the deficiencies of Ker, the Examiner points to Agarwal, which allegedly discloses a heater made of SiN, AlN and SiC. However, the Examiner does not point to any motivation for making this combination, other than to state that "the incorporation of known features from analogous prior art is within the skill of the art." *See* page 5, lines 7-8, April 15, 1998 Office Action.

Applicants respectfully submit that the ability of a skilled artisan to combine two teachings in the art is not the standard for determining obvious. Rather, it is axiomatic that the prior art must provide some motivational teaching for making the combination in order for a *prima facie* case of obviousness to exist.

Additionally, even if a *prima facie* case of obviousness has been established, which it has not, it would be rebutted by the unexpected advantages achieved by forming the claimed heater from the high-emissivity material. Unlike the heater disclosed in Agarwal, the claimed heater is located adjacent the internal electrode, and, therefore, problems of heat accumulation arise. These problems are overcome by the present invention, in which the heater is made of a high-emissivity material. In Agarwal, because the heater is disposed around the outside of the solid electrolyte, the problem of heat accumulation is neither encountered or suggested.

For these reasons, reversal of the Section 103(a) rejection of claim 32, and claims 33-35 and 37, which depend therefrom, is respectfully requested.

(9) CONCLUSION

For all the above-discussed reasons, it is clear that the inventions recited in Applicants' claims are in full compliance with Section 112 and are patentable over the art of record. Accordingly, reversal of all remaining rejections and allowance of claims 21-26 and 31-37 are respectfully requested.

Respectfully submitted,

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(10) APPENDIX: CLAIMS ON APPEAL

12. An oxygen concentration detector comprising:

a sensor element including a solid electrolyte and external and internal electrodes provided on external and internal surfaces thereof, respectively;

a heater provided adjacent to said internal surface of said sensor element;

wherein said internal electrode consists of a material having an emissivity of 0.3 or more, and said external electrode consists of a material having an emissivity lower than the emissivity of said internal electrode; and

wherein a clearance is formed between the heater and the internal electrode, the clearance being 0.1 mm or more.

13. An oxygen concentration detector according to claim 12, wherein said internal electrode consists of platinum black or ruthenium oxide.

14. An oxygen concentration detector according to claim 12, wherein a surface of said internal electrode facing said external electrode consists of a material having an emissivity higher than the emissivity of said external electrode.

15. An oxygen concentration detector according to claim 12, wherein said internal electrode material has an emissivity of more than 0.6.

21. An oxygen concentration detector comprising:

a sensor element including a solid electrolyte and external and internal electrodes provided on external and internal surfaces thereof, respectively;

a high-emissivity layer provided on a surface of said internal electrode; and

a heater disposed adjacent to said high-emissivity layer to form a clearance therebetween, the clearance being 0.1 mm or more, wherein:

said internal electrode has an emissivity less than that of said high-emissivity layer; and

said high-emissivity layer has an emissivity of 0.3 or more, and a porosity more than 10 percent.

22. An oxygen concentration detector according to claim 21, wherein said high-emissivity layer substantially consists of at least one material selected from a group consisting of alumina, titanium oxide, zirconium oxide, iron (III) oxide, nickel oxide, manganese oxide, copper oxide, cobalt oxide, chromium oxide, yttrium oxide, cordierite, silicon nitride, aluminum nitride, and silicon carbide.

23. An oxygen concentration detector according to claim 21, wherein said internal electrode is made of only noble metal.

24. An oxygen concentration detector according to claim 21, wherein said high-emissivity layer has a surface roughness of 1 μm or more.

25. An oxygen concentration detector according to claim 21, wherein said high-emissivity layer has a thickness of 5 μm or more.

26. An oxygen concentration detector according to claim 25, wherein the thickness of said high-emissivity layer is in a range of 10-20 μm.

27. An oxygen concentration detector comprising:

a sensor element including a solid electrolyte and external and internal electrodes provided on external and internal surfaces thereof, respectively;

a heater disposed within said sensor element adjacent to said internal electrode; and

a high-emissivity layer provided on a surface of said heater to form a clearance between said high-emissivity layer and said internal electrode,

wherein said high-emissivity layer has an emissivity of 0.6 or more, and a porosity more than a predetermined value.

28. An oxygen concentration detector according to claim 27, wherein said high-emissivity layer substantially consists of at least one material selected from a group consisting of iron (III) oxide, nickel oxide, manganese oxide, copper oxide, cobalt oxide, chromium oxide, silicon nitride, aluminum nitride, and silicon carbide.

29. An oxygen concentration detector according to claim 27, wherein said internal electrode is made of only noble metal.

30. An oxygen concentration detector according to claim 27, wherein said high-emissivity layer has a surface roughness of 1 μm or more.

31. An oxygen concentration detector comprising:

a sensor element including a solid electrolyte and external and internal electrodes provided on external and internal surfaces thereof, respectively;

a heater disposed at an inner side of said internal electrode to be adjacent to said internal electrode;

a first high-emissivity layer provided on a surface of said heater; and

a second high-emissivity layer provided on a surface of said internal electrode, wherein:

said internal electrode has an emissivity less than that of said second high-emissivity layer;

each of said first high-emissivity layer and said second high-emissivity layer has an emissivity of 0.3 or more, and a porosity more than a predetermined value; and

said first high-emissivity layer is separated from said second high-emissivity layer to form a clearance therebetween, the clearance being 0.1 mm or more.

32. An oxygen concentration detector comprising:

a sensor element including a solid electrolyte and external and internal electrodes provided on external and internal surfaces thereof, respectively; and

a heater disposed adjacent to said internal electrode to form a clearance therebetween, the clearance being 0.1 mm or more;

wherein said heater has an emissivity of 0.6 or more.

33. An oxygen concentration detector according to claim 32, wherein said heater has a polygonal cross-section.

34. An oxygen concentration detector according to claim 32, wherein said heater consists of at least one material selected from a group consisting of silicon nitride, aluminum nitride and silicon carbide.

35. An oxygen concentration detector according to claim 32, wherein said internal electrode is made of only noble metal.

36. An oxygen concentration detector comprising:

a sensor element including a solid electrolyte and external and internal electrodes provided on external and internal surfaces thereof, respectively; and

a heater disposed adjacent to said internal electrode;

a high-emissivity layer provided on a surface of said internal electrode to form a clearance between said heater and said high-emissivity layer, the clearance being 0.1 mm or more,

wherein said high-emissivity layer has an emissivity higher than that of said external electrode,

wherein said high-emissivity layer has a porosity of more than 10 percent.

37. An oxygen concentration detector according to claim 35, wherein each of said external and internal electrodes is made of only noble metal.

IN THE UNITED STATES PATENT AND TRADEMARK OFFICE

R : Appeal t th B ard of Patent App als and Interf r nces

PATENT APPLICATION

In re PATENT APPLICATION of
Inventor(s): TANAKA et al.

Appln. No.:	08	838,910
	Series Code ↑	Serial No. ↑

Group Art Unit: 1744
Examiner.: T. Tung

Atty. Dkt. PMS	235648	41897-US
	M#	Client Ref

Filed: April 11, 1997
Title: OXYGEN CONCENTRATION DETECTOR

(Our Deposit Account No. 03-3975)

(Our Order No.	30954	235648
	C#	M#

Date: 6/15/99

Asst. Commissioner of Patents
and Trademarks
Washington, D.C. 20231

Sir:

1. ☐ **NOTICE OF APPEAL**: Applicant hereby appeals to the Board of Patent Appeals and Interferences from the decision (not Advisory Action) dated _____ of the Examiner twice/finally rejecting claim(s) in this application or in this application and its parent application.
2. ☒ **BRIEF** on appeal in this application attached in triplicate.
3. ☐ An **ORAL HEARING** is respectfully requested under Rule 194 (due two months after Examiner's Answer- unextendable
4. ☐ Reply Brief is attached in triplicate (due two months after Examiner's Answer – unextendable).
5. ☐ "Small entity" verified statement filed: ☐ herewith. ☐ previously.

6. **FEE CALCULATION**

		Large/Small Entity		Fee Code
If box 1 above is X'd, see box 12 below first and decide: ..... enter		$300/150*	$0	119/219
If box 2 above is X'd, see box 12 below first and decide: ..... enter		$300/150*	$300	120/220
If box 3 above is X'd, see box 12 below first and decide: ..... enter		$260/130*	$0	121/221
If box 4 above is X'd, ... enter nothing		- 0 - (no fee)		
7. Original due date: May 15, 1999				
8. Petition is hereby made to extend the original due date to cover the date this response is filed for which the requisite fee is attached.	(1 mo)	$110/$55		115/215
	(2 mos)	$380/$190		116/216
	(3 mos)	$870/$435		117/217
	(4 mos)	$1360/$680	+110	118/218
9. Enter any previous extension fee paid ☐ previously since above original due date (item 7); ☐ with concurrently filed amendment			-	
10. **Subtract line 9 from line 8 and enter: Total Extension Fee**			+110	
11. **TOTAL FEE ATTACHED =**			$410	

12. ☐ *Fee NOT required if/since paid in prior appeal in which the Board of Patent Appeals and Interferences did not render a decision on the merits.

CHARGE STATEMENT: The Commissioner is hereby authorized to charge any fee specifically authorized hereafter, or any missing or insufficient fee(s) filed, or asserted to be filed, or which should have been filed herewith or concerning any paper filed hereafter, and which may be required under Rules 16-18 (missing or insufficiencies only) now or hereafter relative to this application and the resulting Official Document under Rule 20, or credit any overpayment, to our Accounting/Order Nos. shown in the heading hereof, for which purpose a duplicate copy of this sheet is attached. **This CHARGE STATEMENT does not authorize charge of the Issue fee until/unless an Issue fee transmittal sheet is filed.**

Pillsbury Madison & Sutro LLP
Intellectual Property Group

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